Predict the Stock Price of Crash Risk by Using Firefly Algorithm and Comparison with Regression

Esfandyar Malekian[1], Hosein Fakhari[1], Jamal Ghasemi[2], Serveh Farzad[1]*

[1]Department of Economy and Administration, University of Mazandaran, Babolsar, Iran
[2]Faculty of Engineering and Technology, University of Mazandaran, Babolsar, Iran

ABSTRACT

Stock price of crash risk is a phenomenon in which stock prices are subject to severe negative and sudden adjustments. So far, different approaches have been proposed to model and predict the stock price of crash risk, which in most cases have been the main emphasis on the factors affecting it, and often-traditional methods have been used for prediction. On the other hand, using Meta Heuristic Algorithms, has led to a lot of research in the field of finance and accounting. Accordingly, the purpose of this research is to model the Stock price of crash risk of listed companies in Tehran Stock Exchange using firefly algorithm and compare the results with multivariate regression as a traditional method. Of the companies listed on the stock exchange, 101 companies have been selected as samples. Initially, 19 independent variables were introduced into the model as input property of the particle accumulation algorithm, which was considered as a feature selection method. Finally, in each of the different criteria for calculating the risk Stock price of crash risk, some optimal variables were selected, then using firefly algorithm and multivariate regression, the stock price of crash risk was predicted and results were compared. To quantify the Stock price of crash risk, three criteria for negative skewness, high fluctuations and maximum sigma have been used. Two methods of MSE and MAE have been used to compare the methods. The results show that the ability of meta-meta-heuristic methods to predict the risk Stock price of crash risk is not generally higher than the traditional method of multivariate regression, And the research hypothesis was not approved

1   Introduction

Investment in the stock is an important part of the country's economy, so the issue of forecasting is particularly important in developing countries such as ours, in order to manage the stock market for sustainable development properly [7]. The Stock price of crash risk, which is defined as an undesirable event, is a contagious phenomenon at the market level. In this sense, the decline in stock prices is not limited to a single stock, but all of the stock in the market [14], so identifying the factors influencing this phenomenon as well as its proper prediction can be a great help to Decision makers and investors. So far, different approaches have been proposed to model and predict the Stock price of crash

risk using traditional methods. While the stock market has a non-linear, non-static and complex system operating in political, economic and psychological conditions, it is very difficult to use traditional methods for making the right decisions both for managers and investors [1]. This has prompted researchers to anticipate these markets by looking for new ways to make the intolerance and complexity. In the other words, the turbulence of markets, which has led to classical predictive methods such as linear regressions. A modulus and multivariate that has been used extensively in the past has little effect, and on the other hand, with the advancement of technology and science, increased knowledge of expert systems and algorithms that were able to discover the complexities of these systems. The side of this type of algorithm is going to use these techniques for prediction in different categories. By developing nonlinear methods such as fuzzy neural networks, genetic algorithms, cumulative particle algorithms, firefly algorithm, etc., these methods can be used to predict the Stock price of crash risk. Studies show that the use of statistical models has been reduced due to reliance on restrictive assumptions and encourages artificial intelligence techniques, because these techniques are often nonparametric and do not require much initial assumptions in their application. Meta-Heuristic algorithms have attracted more attention, since financial optimization issues encounter a massive and incomplete set of data that change over time. The main advantage of the use of meta-heuristic methods is the limited assumptions in formulating the model, while this is not applicable in mathematical programming. New methods derived from nature that mimic the behavioural patterns of nature, have higher results in issues of other categories. In addition, in financial matters such as bankruptcy predictions, credit ratings and fraudulent financial statements that are considered in all three categories, they are also considered better than those of other methods [21]. This study contributes to the development of research literature in Iran for several reasons:

In this study, by studying the subject literature and the relevant background, a complete set of independent variables that are compatible with the economic conditions of Iran, are available.

Selected and by comparing the dependent variable (risk of falling stock price) and putting the results in the prediction model, and finally, comparing the results with the results of the regression, which has been used in most previous researches, is relatively comprehensive research.

In this regard, the use of a more complete set of variables and the new method for forecasting which are used in other financial and non-financial issues. They have more favourable results than statistical methods. As well as, the simultaneous use of all three criteria for calculating the risk of falling stock price, calculating the dependent variable based on the weekly returns that are more accurate in comparison to seasonal and monthly calculations and comparing the results with one of the most widely used statistical methods, used in previous studies. They can contribute to the development of research literature in this area of finance.

2 Theoretical and Review Foundations

In the literature, several theories and perspectives on the explanation of the phenomenon Stock price of crash risk have been presented Tanani et al. [6]. Black and Christy [10] presented a theory of advantage effects in explaining how the stock price collapses. This theory states that the decrease (increase) in the stock price of a company increases (decreases) it is financial and operational advantage, and, in turn, leads to a fluctuation in stock returns and this asymmetric reaction, causing a negative skewness of stock returns. Blanchard and Watson [8] presented a random bubble stock of price model in explaining the negative stock skewness of stock returns. According to new financial theories, the value of a share is equal to the sum of the present value of its future cash flows. In addition, based on

the efficient market hypothesis, stock prices fluctuate in an efficient market or within its inherent value range. However, at times, due to a shock (the publication of new information, etc.), prices rise without any fundamental justification and, in other words, stock prices are rising dramatically. This process is referred to as the bubble in the financial literature. In recent years, financial issues such as bankruptcy, financial distress, credit risk of banks, and so on have been carried out using meta- heuristic methods. White's first use of neural networks for forecasting in the stock market. He sought out whether nerve networks were able to identify nonlinear rules in time series and unknown rules in asset price movements and stock price changes. After White's initial study in 1988, neural networks were opened to finance, and several studies were carried out. Between 1995 and 1988, there were 213 scientific activities in the field of neural networks in the field of commerce, of which 54 were activities in the field of finance and 2 activities were carried out in the field of forecasting and analysis of time series [30].

Koshino et al. [24] used the flying algorithm to select optimal portfolios. The results of this study showed the superiority of the algorithm of birds to genetic and melting algorithms. Chim et al. [12] used a simulated parody flight algorithm for financial computational applications. Their goal was to predict time series of stock prices and optimal portfolio formation. The results showed that using a bird algorithm, a model can be presented that has the least predictive error and high accuracy. Kumar et al. [25] evaluated derivatives using an antler optimization algorithm. The results showed that improved optimization of ants in predicting the optimal sales time of a bonded bond yields an acceptable performance. The results of the research Adel Azar And colleagues [2] compared the methods of classical and artificial intelligence and hybrid models in predicting stock price index showed that artificial intelligence methods and combination methods have better results than classical methods. Gard et al.[3], in a study comparing the accuracy of earnings forecast prediction using ants and eating algorithms, examined whether the profit management can be found based on machine learning models. The results showed that both algorithms with a high accuracy of 98% have the ability to predict profit management. The results also showed that ant's colony model has more ability to predict profit management than bacterial nutrition model. According to a research study, it has become clear that no research has ever been done on the risk of stock price collapse with meta- heuristic algorithms. Further, some of the foreign and domestic research that has been conducted on the Stock price of crash risk is being examined.

Chen et al. [14] investigated the determinants of stock returns in a study entitled "Stock price of crash risk Forecast Using Trading Volume, Previous Returns, and Contingent Conjugation in Stock Price". It concluded that more negative skewness. In the first six months of the year, there is an increase in the volume of trading, and the second, in the last thirty-six months, has a positive return. Hong and Stein [20] talked about falling stock prices that discrepancy between behavioural investors and investors was a reason to speed up the stock price of crash risk. Their model shows that if the difference between investors in the beginning is high, the hard-line investor, by hearing the smallest bad news badly, is selling his stock quickly, and trying to get out of the market as quickly as possible, which this The move will ultimately lead to a stock price of crash risk. Callen & Fang [13] in a research entitled "Religion and the risk Stock price of crash risk" are investigating whether religiosity is at stake with the risk Stock price of crash risk in the future. Findings of this study show that religion as a set of social norms helps reduce managers' activities in hiding bad news from shareholders.

Vorst [29] explores the impact of capital market competition on the risk of stock price collapse in a study entitled "Capital Market Competition and Risk of Stock Price Risk." He concluded that market

competition Capital has reduced the impact of bad news kept and is linked to a decrease in the probability of a fall. His next test showed that the importance of capital market competition is concentrated in companies with higher information asymmetry. Chen and Kim [16] investigated the relationship between smoothing and the risk Stock price of crash risk in a study entitled "Is Earning Smooth Raising or Reducing the Risk of Falling Stock Risk"? The results indicate the relationship between high-yielding maturity and the risk Stock price of crash risk at high levels. This linkage is intensified in cross-sectional analyses in companies that are less attractive to analysts with lower institutional ownership and accrued accruals.

Tanani et al. [6] in a study entitled "Investigating the Role of Corporate Governance Mechanisms in Reducing Stock Price Risk in Tehran Stock Exchange" examines the role of some corporate governance mechanisms in reducing the stock price risk of accepted companies in Tehran Stock Exchange. The findings of the research indicate a negative and significant relationship between institutional investors and the risk Stock price of crash risk, and a positive and significant relationship between the ratio of unauthorized members of the board of directors and the risk Stock price of crash risk. Dulou (1395) in a study entitled "Financial Transparency, Coincidence and Risk of Stock Price Risk" examined the relationship between the lack of transparency of financial information, the coincidence and the risk Stock price of crash risk. The results of the research suggest that stock price decline cannot be attributed to the lack of transparency of financial information reflected in the financial statements. There was also a lack of transparency and stock price jump. In addition, the lack of transparency of information cannot be claimed as providing less proprietary information to the market and ultimately increasing concurrency. Nahandi and Taghizadeh [4] in a study entitled "Impact of dividend payments and non-publication of bad news on the risk Stock price of crash risk with an emphasis on information asymmetry" examines the impact of dividend payments and non The publication of bad news on the risk of stock price collapse with an emphasis on information asymmetry. Research findings show that dividend payments have a negative and significant effect on the risk Stock price of crash risk. In addition, when the information asymmetry between managers and shareholders is high, the negative effect of dividend payments on the risk Stock price of crash risk is exacerbated. Another consequence is that the lack of publication of bad news has a positive and significant effect on the risk Stock price of crash risk, and the effect is more severe in companies with a high degree of information asymmetry. Therefore, accumulation of bad news results in a negative and more negative return on stocks in the form Stock price of crash risk.

- Sadr Sadat et al. [5] investigated the relationship between profit smoothing and the risk Stock price of crash risk in a study titled "Smoothing and the risk Stock price of crash risk in listed companies in Tehran Stock Exchange." The results showed that there was a significant positive correlation between earnings smoothing and risk of stock price in firms with strong corporate ownership and negative corporate ownership. The results also showed a significant relationship between the profit smoothing and the risk Stock price of crash risk in companies with negative accruals. Ebrahimi et al. [32] in a research entitled Tehran Stock Exchange Forecasting, using a backup vector regression optimized by a firefly algorithm based on a multi-week genetic algorithm with non-recursive sorting, attempts have been made to measure the index The first market of the Tehran Stock Exchange index is expected for the next day. The results of the research show that the accuracy of the combined model increases compared to the simple model. Miley et al. [33], in a research entitled Use of Firefighting Algorithm to predict the financial distress of companies listed on Tehran Stock Exchange, to provide a high-performance predictive model and compare its results with other models. Commonly in anticipation of financial distress. The results showed that the combination of neural network based on the firefly

optimization algorithm has a higher performance than the neural network model as well as logistic regression model

Shiri et al. [34], in a study entitled "Estimating the error of forecasting changes in the stock price index in the pharmaceutical and pharmaceutical industry using artificial intelligence algorithms". Comparison between firefly algorithms, radial base functions, Prestrone multi-layer networks, Colonial Competition and Adaptive Networks predicted stock price changes. The findings showed that the use of these algorithms reduces the forecast error of changes in the index of stock prices at the level of the pharmaceutical and pharmaceutical industry.

3   Methodology of research

Because the results of this research can be used in the decision making process, this research is in terms of the purpose of the application. In addition, this research is in terms of the descriptive-correlation nature, because in this type of research, the researcher seeks to assess the relationship between two or more Varies. The research is conducted within the framework of deductive-deductive reasoning. This means that the theoretical foundations and the history of the research have been carried out through librarian studies and articles, and in an analogous way, and gathering information for confirmation or rejection of the hypothesis, in an inductive form. In this study, Excel, SPSS, E-Viewes and MATLAB software were used to analyse the data and extract the results of the research.

3.1 Research Hypothesis and Statistical Population

The Firefly algorithm based model has more ability to predict the risk of falling stock price versus multivariate regression.

The statistical population of this research includes companies admitted to Tehran Stock Exchange in the period of 2010-2016. In this research, a targeted sampling (Systematic removal) has been used for sampling. For this purpose, all the companies of the society that have the following conditions are selected as the sample and the rest are eliminated;

1) Research is conducted for non-financial companies, so banks and all investment companies, leasing companies and financial institutions are excluded from the sample

2) According to Hutton and Tehranian [19], only companies can be selected as models for implementing the stock price model of a negative skewing model that has at least six months of monthly yield.

3) In order to compare the information, the fiscal year of these companies will be March 29th each year.

4) The financial statements of the fiscal year 2010 to 2016 are available.

3.2 Feature Selection Attitude and Firefly Algorithm

In this study, cumulative particle motion algorithm has been used as a feature selection method. Out of 19 technical indicators that are given as independent variables to the system input, variables that increase the accuracy of predicting the risk Stock price of crash risk in each Select criteria for calculating the risk Stock price of crash risk. Generally, feature selection methods are divided into three groups of filtering, coating and mixing methods. Cumulative particle algorithm is one of the covering techniques, which, according to the learning process, classifies the properties and chooses an optimal subset It offers all the features it offers. One of the advantages of the feature selection process is to increase the accuracy and speed of the implementation of prediction techniques, eliminate unrelated

and unnecessary data, and increase the visibility of the models used. All computations of this section are made using MATLAB software and using The data mining module and its associated operators are done.

The firefly algorithm was first introduced by Yang in 2008. Young has formulated a firefly based on the following hypotheses:

A) Luminous worms lack sex, so all other lightning worms can absorb a firefly.
B) The charm is proportional to the light of the worm and for both firefly, the worm with less lightabsorbs the worm with light, it is also considered by increasing the distance of lightning.
C) If there is no luminous firefighter, the firefly will move randomly. Illumination should be associated with the target function.

In 2009, comparing this algorithm with the algorithms of flying birds and the genetic algorithm, found that this algorithm was better able to find the optimal point in all applications tested [18]. Luminous worms from the family of lampyridae have the ability to emit lightly their own light, which results from the chemical reactions inside their body. The Light system of these insects is used to send alert signals among insects or to attract bait. Over time, this property has evolved to attract pairs. The blinking pattern of the light in these insects depends on the type of insect so that male or female insects emit light with their particular rhythms to absorb the pair; these insects can also group their light emission patterns with Coordinate each other. In Firefly algorithm, F, the primary goal of optical communication is to absorb other luminous worms [31]. The main use of the firefly algorithm is to optimize problems, which is the ultimate goal of maximizing the target function. In this algorithm, the objective function can simply fit the brightness of the light-emitting worms. The process of optimizing this algorithm uses light intensity variations and charm. The attractiveness of a firefly is determined based on the luminance or optical intensity that is obtained from the objective function. In the simplest case for optimization problems where the maximum value of the target function is obtained, the maximum brightness I of a firefly in a unique location of X can fit the amount of brightness with the objective function. $\left(I(x)\alpha f(x)\right)$. However, the charm, "β" is quite relative, and should be seen in the eyes or be judged by other worms. Therefore, the chirality varies with the rij distance between the fireflies the firefighting firefighter j and I. The intensity of the light decreases with increasing distance from its source and light is also absorbed into the environment, so the charm must be allowed to vary with the degree of absorption. The mathematical expression of variations in light intensity is given below. $I = I_0 e^{-\gamma r}$ It is the intensity of the primary light and Y is the light absorption coefficient. In this algorithm, luminous worms move toward worms with more charm. At each step, the rate of displacement of the absorbed worm i towards the firefly is more attractive (brighter) j by the following equation $x_i = x_i + \beta_0 e^{-\gamma r_{ij}}\left(x_i - x_j\right) + \alpha\varepsilon_i$. If there are several optimal points in the area where the worms are released, no worse points of worms will go away if the number of worms is significantly larger than optimal points.

3.3 Introducing variables

In this research, independent empirical evidence has been used to select independent variables. In the next step, the selected variables were entered into the cumulative particle algorithm and finally, a number of independent variables were selected as the optimal variable and entered into the model in

accordance with each of the criteria for calculating the Stock price crash risk. In Fig. 1, the optimal variables are presented for each of the criteria.

Table 1: Optimal variables related to each of the criteria

Maximum Sigma	Swing upward	Negative skewness
Size	Size	Roa
Audquality	Roe	Tax
Mtb	Tax	Lev
Ml	Auditsize	Auditsize
ff	Mtb	Mtb
V	Ml	Ml
Opaque	Ind-ratio	Ind-ratio
	V	Past-return
		V
		Concern
		Deturn
		opaque

In this research, the Stock price of crash risk is considered as a dependent variable. To measure this variable, three of the following criteria are used:

NCSKEW, EXTR-SIGMA and DUVOL,

which are briefly explained below:
-NCSKEW
Chen et al. [14] argue that the signs of stock price collapse are formed a year before the occurrence of this phenomenon, and one of these signs is the existence of a negative tendency to the stock returns of the company. Therefore, companies that have experienced a negative skewness of stock returns in the past year are likely to face falling stock prices next year. Equation 3 is used to calculate the negative skewness of stock returns:

$$NCSKEW_{j,t} = -\left[N(N-1)^{3/2} \sum_{\theta=1}^{\theta=12} W^3_{j,\theta} \right] / \left[(N-1)(N-2)\left(\sum_{\theta=1}^{\theta=12} W^2_{j,\theta} \right)^{3/2} \right] \tag{3}$$

In the above relationship:
- $NCSKEW_{j,t}$: Negative skewness of the stock return of the company j during the fiscal year t, $W_{j,\theta}$: Specific weekly yield of j in month θ, N: The number of weeks in which their returns are calculated.
- EXTR-SIGMA

Bradshaw et al. [11] argued that maximum sigma was used to create a quantitative and continuous measure to measure the Stock price crash risk. In addition, maximum sigma is defined as percussive yields according to the standard deviation of a particular company. To calculate this variable, use the equation 4:

$$EXTR\_SIGMA = -Min\left[\frac{W - \overline{w}}{\partial_W}\right] \tag{4}$$

In this regard:
- w: Average specific weekly returns of the company, ∂w: standard deviation of the company's specific weekly returns,
-DUVOL
Chen et al. [14] argued that the upward oscillation controls the asymmetric fluctuations in returns. In addition, the higher rate of this criterion is more in accordance with the distribution of the left folding. The following is used to compute this variable:

$$DUVOL_{j,t} = -Log\left((n_u - 1)\sum\nolimits_{DOWN} W^2_{j,\theta} / (n_d - 1)\sum\nolimits_{UP} W^2_{j,\theta}\right) \tag{5}$$

In which:
- nu and nd: Number of weeks up and down during the fiscal year t
-Independent variables:
Trading Volume, Return on Equity (V & Past-Return): Chen et al. [14] have predicted a stock price crash risk by three volumes of trades, past stock returns, and stock price skewness. The results of this study indicate that the negative skewness of daily stock returns, or the same phenomenon of price fluctuation in stock, is more specific than the two following: first, an increase in the volume of stock exchanges relative to its trend over the past six months, the second have experienced positive returns over 36 months ago. In this study, the volume of transactions is considered as the data of the number of traded shares per month in millions of shares and past returns is used for past stock returns from stock utilities last year.
- Size: Large companies are motivated to capitalize on capital markets and other markets to reduce their capital costs by increasing the quality of financial reporting and disclosure processes. Hence, there is little chance for large companies to accumulate or disclose bad news. The issue of sudden entry of a mass of bad news to the market prevents the market and thus reduces the Stock price of crash risk [23]. In this research, the size of the company is the natural logarithm of the company's total amounts at the end of the fiscal year.
-Return on assets (Roa): is the ratio of net profit to total assets of the company at the end of the fiscal year.
- Taxation (Tax): Tax payments lead to a reduction in the profit and remaining cash for other stakeholders, including shareholders. This provides grounds for managers' opportunistic actions to refuse to disclose negative information in their personal interest and hide them within the company. When this mass of negative information enters the market, it leads to the collapse of stock prices. In this study, taxes are levied on the division of the tax on profits before tax.
- Conservatism (Consern): Conservatism requires avoiding identifying profits and assets in possible situations, while identifying losses and debts. One can expect that the more conservative the company is, the less likely it is that the bad news of the company will be hidden and accumulated. So, assuming the other conditions are fixed, conservatism is expected to reduce the likelihood of falling share prices in the future. In this study, Khan and Watts [22] model have been used to calculate conservatism. Khan and Watts [22], based on Basu's model [9] used variables representing company characteristics

that are related to conservatism to measure conservatism that has no previous problems. Khan and Watts [22] assume that the scheduling of good news every year. Criscor (GScore). Difference in the timing of bad news every year. CScore. Linear functions of corporate characteristics each year. Size Markets are book value, (M / B) and leverage (Lev); that is,

(2) $GScore \equiv \beta_3 = \mu_1 + \mu_2 Size_i + \mu_3 M/B_i + \mu_4 Lev_i$

(3) $CScore \equiv \beta_4 \lambda_1 + \lambda_2 Size_i + \lambda_3 M/B_i + \lambda_4 Lev_i$

As stated above, the more conservative a company is, the more CScore criteria will be obtained for the company. Finally, Khan and Watts [22], in order to estimate the two GScore and CScore criteria, replace the right sides of equations (2) and (3) in the regression model one β_3 , β_4 in addition to adding control variables.
- Financial Flexibility (FF): Managers try to secure themselves in a way to prevent future incidents and occurrences. One of the basic tools to meet this important issue is the use of financial flexibility policies that companies use in situations. Critical can be very well suited to the situation, and this can lead to a firm's stock price, which is a function of the company's performance and ability to deal with the opportunities and risks ahead It comes guarded against the risk of collapse.

In this study, we will use the following formula to determine the excess capacity of debt:

$$LEV_{i,t} = \beta_1 LEV_{i,t-1} + \beta_2 INDLEV_{i,t} + \beta_3 M/B_{i,t}$$
$$+ \beta_4 Size_{i,t} \beta_5 Tan_{i,t} + \beta_6 Profitability_{i,t} + \beta_7 Inflation_t + \varepsilon_{i,t}$$
In which

LEV, debt ratio to the company's assets,

IndLEV, the median debt of the companies in the industry, M / B is the ratio of market value to the book value that is measured by the total debt and the stock market value of the assets, Size, company logarithm.

Tan, ratio of fixed assets to total assets, Profitability, Profit before interest and tax, Assets, Inflation, Inflation, based on the growth of the Central Bank's announced consumer price index, €, other factors
- The lack of transparency of financial information (Opaque):

Huton et al. [19] argue that in the absence of transparency in financial reporting (profit management). Managers are motivated to conceal a portion of their business to maintain their jobs. This process, that is, disclosure of real losses continues until the presence of the manager in the company. After the company leaves the manager, a huge amount of unexplained losses enter the market, leading to a stock price of crash risk. In this study, the Jones model is used for its estimation and is used as the absolute value of DAI three years ago.

- Leverage (Lev): According to Huton et al. [19], an increase in corporate debt could lead to higher interest rates. Therefore, increasing the advantage ratio can lead to a reduction in the profit margin. Therefore, the high volume of debt in a company's capital structure can be a ground for creating a negative skew for stock returns. The financial advantage is equal to the financial facility divided by the sum of the assets of the end of the period of the company.

- Dturn: Hong and Stein [20] have used this variable in their research and argue that investors' heterogeneity lead to further collapse. The heterogeneity of investors is the average random stocking of stocks in the current fiscal year, minus the average random turnover of stocks in the past year. The average random stocking of stocks is obtained by dividing the monthly volume of shares by the total number of shares issued during the month.

- Auditor's opinion (QUALIFIED): Research shows that investors report a negative reaction to a revised audit report (in particular contingent comments) and construed this as a negative report (Chen et al. [14]. Therefore, it can be concluded that an audited audit report has information content. In this research, the opinion of the auditor is equal to one if the audit report is of a modified type (conditional) and otherwise zero.

- The size of the Audit Institute (BIG): If more quality audits are carried out, it reduces the cost of representing and aligning the interests of managers and investors, reducing executives' violations, improving operational decisions, and reducing foreclosures. . In this case, the risk of falling future stock prices decreases. In this study, the size of an audit firm is equal to one if the audit firm is an audit firm and otherwise zero

- Return on Equity (ROE): Hutton et al. [19] argued that companies with higher return on equity (as a benchmark for better performance) risk lower stock prices. Is the ratio of net profit to total equity of the company at the end of the fiscal year?

-The Market Value of Equity (MTB): Khan and Watts [22] have argued that companies with a higher market share of their equity market have more investment opportunities. This could be the risk of collapse Increase stock prices. Therefore, it is equal to the ratio of the market value to the book value of the rights of the owners of the company.

-Independence of the Board of Directors (Ind-Ratio): The presence of unauthorized members in the composition of the board reduces the information asymmetry between the company's internal and external components, which leads to an increase in the quality of disclosure of information and thus to reduce the risk Stock price crash risk. Panayiotis et al., [27] the independence of the board of directors is calculated by the percentage of the proportion of non-executive directors to the entire board of directors.

- Working Capital Management (ML): Failure to maintain a good level of liquidity for a company makes it impossible for a company to use short-term investment opportunities and does not have the timely access to the raw materials needed to produce the goods and satisfy customers' needs. Be continuing this situation may lead to a stock price of crash risk of the company and ultimately lead to a devaluation of the business to terminate the business. This variable is calculated using the cash flow cycle model Lazaridis [26] as follows:

Cash Flow Cycle = Inventory Conversion Period + Conversion Period Conversion - Deferred Creditors Period

4   Research Results
4.1 Descriptive statistics

The results of the descriptive statistics of the variables of the research are shown in Table 2.

4.2 Test hypothesis

Since one of the suitable criteria for comparing different prediction methods is the prediction error, the difference between the predicted model and the actual value of the variable is the two criteria of the mean square error (MSE) and (MAE) in order to compare Between   Meta Heuristic Algorithm and regression are used.

Table 2: Descriptive statistics of research variables

Minimum	Maximum	Standard deviation	Average	Variable
0.20	4	1.28	1.50	EXTR-SIGMA
-6.52	6.81	0.61	0.36	NCSKEW
-0.13	2.99	0.29	0.29	DUVOL
4.98	8.22	0.69	6.85	size
-0.24	0.98	0.13	0.60	ROA
0.23	3.02	0.30	0.57	MTB
0.10	0.21	0.11	0.16	Tax
0.13	0.93	0.20	0.60	LEV
0	1	0.45	0.30	BIG
0	1	0.50	0.48	QUALIFIED
-0.85	0.90	0.30	0.53	ROE
0.10	0.99	0.20	0.26	ML
0.20	0.85	0.15	0.67	INT-RATIO
-0.54	1.23	0.20	0.55	PAST-RETURN
0.04	1.93	0.19	0.11	OPAQUE
-2.01	2.97	0.33	0.14	Consern
-0.46	0.50	.055	.033	DETURN
0	1	0.33	0.13	FF

Table 3: Independent Samples Test- MSE

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
									Lower	Upper	
VAR00001	Equal variances assumed	19.094	.000	1.681	34	.102	.0263611	.0156813	-.0055	.0582292	
	Equal variances not assumed			1.681	19.001	.109	.0263611	.0156813	-.0065	.0591822	

- Fierfly algorithm based model has more ability to predict the Stock price Crash risk than regression.
. In order to compare the results, we use the mean comparison test. This test is used when the hypothesis is proposed to compare the mean of the two communities (groups). To test the mean equality of two societies, it is necessary to first check whether the variance of the two societies is equal or not. In other words, the test of equality of variances takes precedence over the equation test. Levin test is used to test the equality of variances. In this test, the zero hypothesis is equal to all the variances of the groups. In this test, if the value of Sig for the Levine test is smaller than the significance level of 0.05, then the zero assumption of equalization of variances is rejected and the claim for non-equality of variances is accepted. So we look at the second row information for the conclusion about the mean Then, according to the Sig test of the mean, the zero hypothesis is confirmed or rejected, if the value is less than 0.05, the assumption is zero and the claim for the inequality of the meanings is accepted. In this case, given the upper and lower limits, we can say:

1- Whenever low and upper positive are positive, the average difference between two societies is larger than the average, and the average of the first society is larger than the second society.
2- Whenever the lower and upper are negative, the difference between the two societies is less than zero, and the average of the first society is smaller than the second society.
3- Whenever the upper limit is positive and the lower limit is negative, the difference between the mean of the two societies is not significant and the average equality of the two societies is not rejected.

Table 3 shows the results of independent t-test in the MSE error criterion. Considering the significance level of the Levine test, which is zero and this value is less than 0.05, so the assumption of the equality of variances is rejected and we use the second row information for the conclusion of the averages. In the second line, the significance level table for comparing the means is equal to 0.109, which is greater than 0.05, so the claim that the meanings are not equal is not accepted. The fourth hypothesis that the firefly algorithm has a higher ability than multivariate regression is not accepted

Table 4: Independent Samples Test-MAE

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
VAR00001	Equal variances assumed	10.629	0.003	1.533	34	0.134	0.0195611	0.0127579	-0.006366	.0454883
	Equal variances not assumed			1.533	20.947	0.140	0.0195611	0.0127579	0.0069745	0.0460967

Table 4 shows the results of independent t-test in the MAE error criterion. Considering the significance level of the Levine test, which is equal to 0.003, this value is less than 0.05. Therefore, assumption of the equality of variances is not accepted and we use the second row information to conclude the averages. In the second, line, the significance level table for the comparison of averages is equal to 0.14, which is greater than 0.05. So the claim that the meanings are not equal is not accepted and the fourth hypothesis is that the ability of the fire-fly algorithm model is potentiality more than multivariate regression in predicting the risk of falling stock prices, is not accepted. Therefore, the results of the hypothesis test showed that the hypothesis of the study that the ability of the firefly algorithm to multi-variable regression is higher in predicting the risk of falling stock prices is not confirmed in both error criteria.

5   Discussion and Conclusion

Investors are always concerned about protecting their investment and endangering of the stock price of crash risk. The stock price of crash risk is a crucial element in the return on equity for investors, because, unlike the risks posed by systematic fluctuations, diversification cannot be reduced. Therefore, the exact prediction of the risk of falling stock prices of companies is an issue of importance for financial decisions. On the other hand, in previous studies, the factors influencing the risk of falling stock prices have always been studied. In all of these studies, regression has been used as a model for forecasting, while the stock market has a nonlinear, non-stationary and complex system. It works in political, economic and psychological conditions, so it is very difficult to use traditional methods for making the right decision for both managers and investors. This has led the researchers to move towards the use of modern practices in stock market forecasts. Meanwhile, meta-surgical methods have been highly regarded as inspirational ways. Therefore, in this research, after collecting the necessary data and data, the variables studied in the sample companies were calculated, and then using the feature selection method, we chose to select the optimal variables in each of the criteria for calculating the risk of falling stock prices. Then, the risk of stock price collapse was determined using multivariate regression and firefly algorithm, and finally, with the aid of two criteria of MSE and MAE error, the ability to predict different methods was studied. The comparative test was used to compare the two independent societies (independent t-test). The findings presented in Tables 3 and 4 for each error. The significance level for the comparison of the means in the error of MSE and MAE is equal to 0.109 and 0.140 respectively, which is greater than the significance level of 0.05, so the claim for the inequality of the meanings is not acceptable. In this way, the hypothesis is rejected. The results are not consistent with the research by Ebrahimi et al. [32], Miley et al. [33] and Shiri et al. [34], which are related to changes in stock price index.

References

[1] Afsar, A., *Modeling the stock price index forecast using Fuzzy Neural Networks and Combined Techniques.* Tehran: Master's thesis, Tarbiat Modares University, 2014 (in Persian)

[2] Azar, A., Afsar, A., Ahmadi, P., *Comparison of Classical and Artificial Intelligence Methods in stock price prediction and design of a hybrid model. Management Research in Iran*, 2006.

[3]   Gard, A., Waqfi, H., Habibzadeh, J., Khaje Zadeh, S., *Comparison of earnings forecast prediction using alimentary algorithms and bacterial nutrition.* Journal of Empirical Accounting Research, 2014, 4(15), P.181-203.

[4]   Nahandi, Y., Taqizadeh, V., *The effect of paying dividends and not releasing bad news on the risk Stock price of crash risk with an emphasis on information asymmetry.* Accounting and Auditing Reviews, 2016, 24(1), P.40-19.

[5]   Sadr S., Sotoudeh Nia, L., Salman, Amiri, A., *The study of the relationship between profit smoothing and the risk Stock price of crash risk in companies admitted to the Tehran Stock Exchange,* New Research in Management and Accounting, 2016, 21, P. 230-207.

[6]   Tanani, M., Sedighi, A., Amiri, A., *Investigating the role of corporate governance mechanisms in reducing the stock price risk of companies accepted in Tehran Stock Exchange.* Quarterly Journal of Asset & Finance Management, 2014, 4, P.234-255.

[7] Toloui, A., Hagh doost, Sh., *Modeling the stock price forecast using a neural network and comparing it with mathematical prediction methods*, Economic Research, 2006, 5, P.252-237.

[8] Blanchard, Olivier J. and Watson, Mark W., Bubbles*, Rational Expectations, and Financial Markets, in Paul Wachtel, ed., Crises in Economic and Financial Structure. Lexington MA: Lexington Books*, 1982, 55, P.295-315.

[9] Basu, S., *The conservatism principle and the asymmetric timeliness of earnings.* Journal of Accounting. & Economics, 1997, 24, P.3-37.

[10]   Bleck, A., Liu. X., *Market Transparency and the Accounting Regime.* Journal of Accounting Research, 2007, 45 (2), P.229-256.

[11] Bradshaw. Mark T; Hutton; Marcus Alan J; and Hassan Tehranian, *Opacity; Stock price of crash risk Risk and Option Smirk Curves,* Boston College, 2010.

[12]   Chiam, S., Tan, K., and Mamun, A., *A memetic model of evolutionary PSO for computational finance applications.* Expert Systems with Applications, 2009, 36, P.3695-3711.

[13] Callen Jeffrey L; Fang X., *Short interest and stock price stock price of crash risk risk. Journal of Banking and Finance,* 2015.

[14] Chen J., H. Hong, *Forecasting stock price of crash risks: trading volume, past returns, and conditional skewness in stock prices.* Journal of Financial Economics, 2001, 61(3), P.345-381.

[15] Chen, C.J.P., Su, X. and Wu, X., *Auditor Changes Following A Big Merger with a Local Chinese Firm: A Case Study.* Auditing a Journal of Practice & Theory, 2010, 29(1), P.41-72.

[16] Chen, C. J., Kim, L., *Earning Management Will Exacerbate or Reduce Stock price of crash risk?* A Journal of Corporate Finance, 2017, 42, P.36-54.

[17] Dallagnol, V., Vandenberg, F., Mous, L. *Portfolio Management Using Value at Risk: A Comparison between Genetic Algorithm and Particle Swarm Optimization.* International of intelligent System, 2009, 2(4), P.729-766.

[18] Yang, X-S., *Firefly Algorithms for Multimodal Optimization, in: Stochastic Algorithms. Foundations and Applications, SAGA*, Lecture Notes in Computer Sciences, Cambridge, UK, 2009, 57, P.169-178.

[19] Hutton, A.P., Marcus, A.J., Tehranian, H., *Opaque financial reports, R2, and stock price of crash risk risk.* Journal of Financial Economics, 2009, 94, P.67-86.

[20] Hong, H. and J. C. Stein., *Differences of opinion, short sales constraints, and market stock price of crash risks.* Review of financial studies, 2003, 16(2), P.487-498.

[21] Katsis. C.D., Golets.Y., Boufounou P.V., *Using Ants to Detect Fraudulent Financial Statements.* A Journal of Applied Finance & Banking, 2012, 2(6), P.73-89.

[22] Khan, M., Watts, R.L., *Estimation and empirical properties of a firm-year measure of accounting conservatism.* Journal of Accounting and Economics, 2009, 48, P.132-150.

[23] Kim, J.,Zhang, L., *Does Acconting Consevatism Reduse Stock Price Stock price of crash risk*, 2010, 55, P.24-56.

[24] Koshino, M., Murata, H., and Kimura, H., *Improved Particle Swarm Optimization and Application to Portfolio Selection.* Electronic and Communications in Japan, 2007, 90, P.35-68.

[25] Kumar S., Thulasiram R.K., Thulasiraman P., *On Colony Optimization for Option Pricing. In: Brabazon A., O'Neill M. (eds) Natural Computing in Computational Finance*. Studies in Computational Intelligence, 185, Springer, Berlin, Heidelberg, 2009.

[26] Lazaridis I., Tryfonidis D., *The Relationship Between Liquidity Management and Profitability of Listed Companies in the Athens Stock Exchange*. University of Macedonia, Department of Accounting & Finance, 2008, 54, P.1-5.

[27] Panayiotis C.A., Constantinos A., Joanne H., and L. Christodoulos, *Corporate Governance and Firm-Specific Stock PriceStock price of crash riskes*, 2015.

[28] Tehran, R., Khodayar, F., *Optimization of Artificial Neural Networks Using Firefly algorithm Algorithm to Predict the Variation of the Stock Price Index*. Journal of Applied Sciences, 2010, 10(3), P.345-356.

[29] Vorst, P., *Equity Market Competition and Stock Price Stock price of crash risk Risk. Maastricht University*, School of Business and Econ, 2016.

[30] White, H., *Economic prediction using neuralnetwork:The case of IBM daily stock returns*. IEEE International conference on Neural Networks, San Deigo, 1988, 2, P.451-458.

[31] Yang, X-S., *Fiefly Algorithm, Stochastic Test Functions and Design Optimization*. International Journal of Bio-inspired Computation, 2010, 2(2), P.78-84.

[32] Ebrahimi, S. K., Rahmani Mansesh M., Bahramini Nasab A., Shafiee, N., *Tehran Stock Exchange Index Estimation Using Backup Vector Regression Optimized by Firefighting Algorithm Based on Multi-objective Genetic Algorithm with Non-Diffuse Sorting,* Second Conference Annual Economics, Management and Accounting, Ahvaz, Shahid Chamran University - Khuzestan Industry, Mine & Trade Organization, https://www.civilica.com/Paper-EMAC02-EMAC02_342.html, 2017

[33] Miley, A., Eivazlou, R, Fallahpour, S., *The use of firefighting algorithm to predict the financial distress of companies accepted in Tehran Stock Exchange*, Master's thesis, Faculty of Tehran, Tehran University, Financial engineering, 2014,

[34] Shiri, M., Salehi, M., Hamidehpour, K., *Estimating the error of predicting stock price index changes in the pharmaceutical and pharmaceutical industry using artificial intelligence algorithms.* Health Accounting for the fourth year of issue, 2014.